

Accuracy of touch method for assessing temperature in newborn

Ancy Anto¹, Shiny Mathew², Chandrakala Bada Shekharappa³

From ¹Nursing Postgraduate, Department of Child Health, Associate Professor; ²Department of Child Health, St. John's College of Nursing; ³Department of Neonatology, St. John's Medical College Hospital, Bengaluru, Karnataka, India

Correspondence to: Dr. Chandrakala Bada Shekharappa, Department of Neonatology, St John's Medical College Hospital, Bengaluru, Karnataka, India. E-mail: bms_chandra@yahoo.co.in

Received - 29 June 2018

Initial Review - 15 July 2018

Accepted - 27 July 2018

ABSTRACT

Introduction: Early recognition of hypothermia by the mother or a health worker is crucial to institute corrective actions to improve the survival of newborn babies. Hand-touch technique is a simple, practical, and inexpensive method that has been promoted for assessing neonatal hypothermia in resource-poor countries. **Objective:** The objective of this study is to compare the accuracy of touch method as assessed by mothers with the axillary method (standard technique) and to find the association of maternal variables with the accuracy of touch method. **Materials and Methods:** In this diagnostic study, postnatal babies with birth weight >2 kg and gestation >35 weeks were included within 24 h of birth after the parental consent. Those babies who were shifted to neonatal intensive care unit were excluded from the study. Investigator demonstrated the touch method of assessing temperature to the mother, and the temperature assessed by the mothers was then compared with the standardized temperature measurement technique in the axilla. Babies were classified into two groups, i.e., hypothermia or no hypothermia (normothermia). **Results:** A total of 82 mother-baby dyads were studied. Of 22 (26.83%) babies, who were hypothermic by axillary temperature, mothers could correctly categorize only 11 (50%) babies as hypothermic by touch method. Of 60 (73.17%) babies who had normal temperature as assessed by axillary method, 40 (66.67%) babies were correctly categorized as normothermic by touch technique. Sensitivity, specificity, positive predictive value, and negative predictive value of touch method by the mother and the investigator was 50%, 66%, 35.48%, and 78.43% and 78.33%, 81.82%, 92.16%, and 58.06%, respectively. **Conclusion:** The sensitivity of the touch method as assessed by the mother to detect hypothermia is poor. However, adequate and frequent training and experience of the mother can improve the sensitivity. The study could be recommended to perform with larger sample size.

Key words: Accuracy, Mother, Newborn, Standard technique, Touch method

Hypothermia is increasingly recognized as a major cause of neonatal morbidity and mortality in resource-poor settings, and it is the fourth leading cause of neonatal death [1,2]. It is estimated that 16% of the hypothermic neonates (<36°C) die during the 1st week of life [3]. Hypothermia in newborns can lead to an increased rate of basal metabolism, peripheral vasoconstriction, decreased peripheral perfusion, tissue ischemia, and finally metabolic acidosis. Vascular changes in the lungs may result in decreased ventilation, increased demand for oxygen, and worsening of respiratory distress. Meanwhile, acidosis and hypoxia can predispose the newborn to pulmonary hemorrhage and disseminated intravascular coagulation. Hepatocyte ischemia affects liver function and may cause indirect hyperbilirubinemia. In addition, the high metabolic rate leads to higher glucose consumption and hypoglycemia [4].

Hypothermia is defined as a core temperature below 36.5°C. A temperature of 36–36.4°C is considered as mild hypothermia (cold stress), 32–36°C as moderate hypothermia, and <32°C as severe hypothermia. Baby's temperature can be assessed with reasonable precision by human touch, the reliability of which can be enhanced by training [5]. High prevalence of hypothermia

has been reported widely from warmer high mortality regions of Africa and South Asia. A study from Shimla presented that overall mortality was 51% among hypothermic neonates from North India. Hypothermia contributed to 9.6% of total neonatal deaths in Shimla which is in contrast to 1.4% from Varanasi [6].

The World Health Organization recognizes newborn thermal care as a component of critical and essential newborn care. However, hypothermia continues to remain underdocumented, underrecognized, and undermanaged and the health workers and/or the caregiver's are burdened with the responsibility to assess the newborn's temperature by valid method. Low reading mercury (LRM) thermometer was considered best and gold standard for measuring hypothermia since its invention [7]. LRM thermometers are, however, fragile and potential for mercury vapor toxicity following breakage [8], and they are difficult to obtain in many parts of the world [9]. However, these thermometers are unaffordable and impractical in many developing countries, like Nepal.

Considering the high prevalence of hypothermia experienced by newborns in developing countries, the need was to identify a simple, affordable yet effective tool for detecting hypothermia

that can be used by the mothers and other caregivers at home or in the periphery. This is crucial to reduce perinatal and neonatal mortality and morbidity. Abdominal temperature is representative of the core temperature, and it is reliable in the diagnosis of hypothermia. The warm and pink physical appearance of the baby indicates that the baby is in thermal comfort. However, when feet are cold and trunk is warm, it indicates that the baby is in cold stress or mild hypothermia, and in moderate hypothermia, when both the feet and trunk are cold to touch [5].

Hand-touch method is a simple, practical, and inexpensive method, which has been promoted for assessing neonatal hypothermia in countries having poor resources [10]. It has shown good diagnostic validity compared with LRM thermometer; therefore, this method can be introduced in essential newborn care package after giving adequate training for caregivers [11].

A study by Singh *et al.*, which was done under urban health resource conditions in India, showed that the prevalence of hypothermia in India is 30.9% which insignificantly varies along with the different seasons. This study also proved that human touch has moderate accuracy [10]. It was reported that the sensitivity of diagnosing skin temperature of $<36^{\circ}\text{C}$ by touching the abdomen was 100% and specificity around 90%. It was suggested that, with training and experience, human touch could accurately predict the temperature of the abdomen or sole of the foot with an accuracy of $\pm 0.5^{\circ}\text{C}$ [10].

Early recognition of hypothermia by the mother or a health worker is crucial to institute's corrective action to reduce the severity of hypothermia and to improve the survival of newborn babies. Feeling the temperature of the baby could be an important way of assessing hypothermia in places where thermometer is not available. A study, therefore, needs to be done to determine if training mothers and field worker can improve their ability of identifying hypothermic babies by human touch method without using a thermometer. The primary objective of the study was to compare the accuracy of touch method by mothers with the standardized temperature measurement (axillary), and the secondary objective was to find the association between accuracy of touch method and maternal baseline variables.

MATERIALS AND METHODS

This diagnostic study was conducted in the postnatal and private wards of a tertiary care center, Bengaluru, over the duration of 6 months. The clearance from the Institutional Ethical Committee was obtained before the study. The study population (mother and baby dyad) was recruited based on the inclusion and exclusion criteria after the informed consent. All term babies with weight more than 2 kg, gestation more than 35 weeks, and their mothers were included in the study. The babies requiring neonatal intensive care unit, within 24 h of birth, were excluded from the study.

Sample size calculation criteria were selected according to Agarwal's *et al.* study [12], in which only 69% of the babies with normal temperature as assessed by axillary method were classified as having normal temperature by the touch method. To arrive at this proportion of correct classification with 10% precision

and 95% confidence interval, a sample size of 82 subjects was required.

A structured proforma was used to collect the baseline variables of the baby and mother. The investigator demonstrated the touch method using dorsum of the right hand to assess newborn's skin temperature at the abdomen (just below the umbilicus) and soles of the feet and taught the same procedure to the mother. The mother was educated on neonatal hypothermia and its classification. She was trained to detect normothermia, when both abdomen and soles were warm, mild hypothermia when abdomen was warm and soles were cold and moderate hypothermia when both abdomen and soles were cold respectively [13,14]. For the study purpose, mother was asked to assess the temperature of newborn using touch method [15] and label the babies as hypothermic or normothermic. The health personnel (investigator) also assessed the temperature of newborn using touch method and then by standardized method, i.e., by placing the mercury thermometer's tip high in the baby's axilla, after ensuring that it is free from moisture using a cotton ball. The baby's folded arm was placed over the chest for 3 min. The thermometer reading was recorded by the investigator in the vital sign chart. The clinical mercury thermometer was calibrated and certified by RRK Process Instrument Company.

A pilot study was conducted on 10 mother and baby dyads, based on the inclusion criteria. The findings of the pilot study helped us to gain insight into the feasibility of enrolling mother and baby dyad as part of the study.

Descriptive statistics such as frequency, percentage for categorical variables, and mean with standard deviation for continuous variables were reported. Cross tabulation between axillary temperatures (considering this as the gold standard) with touch method by mothers and investigator was done. McNemar Chi-square test was used to compare the proportions between two methods. Sensitivity, specificity, positive predictive value (PPV), and negative predictive values (NPV) of the touch method were compared with the gold standard which was reported. $p < 0.05$ was considered statistically significant.

A brief description of the parameters that were included in this study is as follows: (1) Sensitivity is the proportions of babies with hypothermia as detected by axillary temperature, who were identified hypothermic using touch method by mothers. (2) Specificity is the proportion of babies without hypothermia as detected by axillary method, who were marked as normothermic using touch method. (3) PPV shows that the proportions of babies, who were identified as hypothermic by touch method, actually had hypothermia as detected by axillary method. (4) NPV shows the proportion of babies who were identified as normothermic/no hypothermia by touch method and who did not have hypothermia by axillary temperature technique.

RESULTS

The total number of babies born during the study period was 346. Of 117 eligible mother-baby dyads, 82 were included in the study, and there were 42 (51%) girl infants included. The mean

maternal age was 25.35 ± 3.5 years, and the mean birth weight and gestation of the included babies were 3.09 ± 0.47 kg and 39 ± 1.03 weeks, respectively. A total of 64 (78.05%) mothers were belonged to uneducated category and 36 (43.90%) mothers were educated having intermediate/post-high school diploma. A total of 66 (80.49%) mothers underwent normal delivery. Majority of the mothers' (37.8%) family income was between rupees 4810 and 8009. The primary outcome of this study is shown in Table 1.

A total of 22 (26.83%) babies were as assessed by axillary temperature, whereas mothers could correctly categorize only 11 (50%) babies as hypothermic by touch method. Of 60 (73.17%) babies who had normal temperature as assessed by axillary method, 40 (66.67%) babies were correctly categorized as normothermic by touch technique. Sensitivity, specificity, PPV, and NPV of touch method by the mother were 50%, 66%, 35.48%, and 78.43%, whereas it was 78.33%, 81.82%, 92.16% and 58.06% by the investigators, respectively. Diagnostic accuracy of the touch method by the mother and the investigator was 62% and 80%, respectively. There was no statistical significant association between the touch perception of mother with her age ($p=0.106$), education ($p=0.404$), mode of delivery ($p=0.080$), and number of deliveries ($p=0.643$).

DISCUSSION

It is mandatory to identify hypothermia early, to reduce neonatal morbidity and mortality, and this study was a step to access baby's temperature with reasonable precision by human touch. It was also assumed that the study will help to teach the exact technique to the mothers to recognize the early signs. In the present study, the mean age of the mothers was 25.35 ± 3.5 years and majority of the babies were delivered vaginally, and only 16 (19.5%) were delivered by cesarean section. The mean birth weight and gestation were 3.09 ± 0.47 kg and 39 ± 1.03 weeks, respectively.

Of the 82 babies studied, 22 (26.83%) were hypothermic by axillary temperature method, and of them, only 11 (50%) babies were categorized as hypothermic by touch method by their mothers. Of 60 (73.17%) normothermic babies, only 40 (66.67%) were correctly categorized as having normal temperature by touch method. In contrast, a study by Kumar R *et al.* showed that, of 189 babies, 32.3% were hypothermic, and 24.59% were correctly identified by the mothers [5]. In our study, the sensitivity of picking hypothermia by mothers was 50% and specificity was 66.66%, which was similar to the above study.

In another study by Singh *et al.*, babies with skin temperature of $<36.5^\circ\text{C}$ were correctly picked up by all the three observers (pediatricians having a minimum of 5 years' experience) in most of the instances [10]. In the same study, the sensitivity of diagnosing skin temperature of $<36^\circ\text{C}$ by touching the abdomen was 100% with a specificity of around 90%. In our study, sensitivity and specificity to pick up hypothermia by health personnel using the touch method were 78.33% and 81.82%, respectively. As compared to this study where the assessors were the doctors who had a minimum of 5 years of experience, sensitivity in our study to pick up hypothermia was less (78.3%).

In another study by Agarwal *et al.* [12], where health-care volunteers (field workers) assessed temperature by touch method in 152 newborns, the sensitivity was 74.5%, specificity was 68.5%, PPV was 51.4%, and NPV was 85.7%. The study concludes that the touch method has moderate accuracy. Another study by Tuitui *et al.* [11], which assessed the use of touch method by health workers (Nurses) to detect hypothermia among 100 newborns, It implied that palpation of feet shows high sensitivity of 95.5%, with specificity of 70.1%, PPV of 48.8%, and NPV of 98.2% in picking up hypothermia as compared to axillary method. Health personnel's perception sensitivity (74.5%) was also scored less in our study.

In our study, health personnel was the investigator herself, who assessed temperature by touch method, and the sensitivity and specificity were closer to other studies [11,12]. Similarly, the mother's assessment of hypothermia by touch technique is also similar to other study [5]. It was observed that both the investigator's (clinically experienced) and mother's accuracy in assessing the temperature by touch method are very much different (78% vs. 50%), and both were low as compared to other studies [11,12]. The reason for the low sensitivity of the mother could be that the mother was taught only once to assess temperature by touch method. In a study, Singh *et al.* [10] showed 100% sensitivity and 90% specificity of touch method and concluded that, with training and experience, human touch could accurately predict the temperature of abdomen or sole of foot with an accuracy of $\pm 0.5^\circ\text{C}$. The method is simple and programmatically more feasible for field settings, for early neonatal sickness identification at the community level. The knowledge that is gained by this study is used in discharge advice on danger sign and to get back to the facility if this danger sign is present.

The limitations found in our study are stated as follows: Mean gestation of the included babies in our study was 39 weeks, who

Table 1: Mothers and investigator's temperature, as assessed by touch technique compared with the standard temperature technique (n=82)

Temperature assessment	Axillary temperature (Standard technique)		Sensitivity	Specificity	PPV	NPV
	$>36.5^\circ\text{C}$	$<36.5^\circ\text{C}$				
Mother's assessment						
No hypothermia	40	11	50.00	66.66	35.48	78.43
Hypothermia	20	11	-	-	-	-
Investigator's assessment						
No hypothermia	47	4	78.33	81.82	92.16	58.06
Hypothermia	13	18	-	-	-	-

PPV: Positive predictive value, NPV: Negative predictive value

are at low risk of hypothermia. Sick babies and low birth weight babies, who were more prone to hypothermia, were excluded from the study. Due to the time constraint, the sample size calculated was for 10% precision instead of 5%. Smaller sample size might have contributed for the poor sensitivity of the touch technique.

CONCLUSION

The sensitivity to detect hypothermia by touch method as assessed by the mother is poor. However, adequate and frequent training and experience of the mother will improve the sensitivity. The study with the larger sample size is needed.

ACKNOWLEDGMENT

We thank Mr. Jeeva MK and Mrs. Sumitra from the Department of Biostatistics for their support in the statistical analysis.

REFERENCES

1. Dragovich D, Tamburlini G, Alisjahbana A, Kambarami R, Karagulova J, Lincetto O, *et al.* Thermal control of the newborn: Knowledge and practice of health professional in seven countries. *Acta Paediatr* 1997;86:645-50.
2. Department of Health Services, Ministry of Health. National Neonatal Health Strategy. Kathmandu: Department of Health Services, Ministry of Health; 2004.
3. Johanson RB. Diagnosis of hypothermia-a simple test? *J Trop Pediatr* 1993;39:313-4.
4. Nayeri F, Nilli F. Hypothermia at birth and its associated complications in

newborn: A follow up study. *Iran J Publ Health* 2006;38:48-52.

5. Kumar R, Aggarwal AK. Accuracy of maternal perception of neonatal temperature. *Indian Paediatr* 1996;33:583-5.
6. Kaushik SL, Grover N, Parmar VR, Kaushik R, Gupta AK. Hypothermia in newborns at Shimla. *Indian Pediatr* 1998;35:652-6.
7. WHO. Thermal Protection of the Newborn: A Practical Guide. Geneva: Maternal and Newborn Health/Safe Motherhood Unit; 1997.
8. Bhattacharya B, Banerjee S, Singhi S. Acute mercury vapour poisoning in an infant. *Ann Trop Paediatr* 1997;17:57-60.
9. Kumar V, Shearer JC, Kumar A, Darmstadt GL. Neonatal hypothermia in low resource settings: A review. *J Perinatol* 2009;29:401-12.
10. Singh M, Rao G, Malhotra AK, Deorari AK. Assessment of newborn baby's temperature by human touch: A potentially useful primary care strategy. *Indian Pediatr* 1992;29:449-52.
11. Tuitui RL, Suwal SN, Shrestha S. Hand-touch method for detection of neonatal hypothermia in Nepal. *J Trop Pediatr* 2011;57:236-8.
12. Agarwal S, Sethi V, Srivastava K, Jha P, Baqui AH. Human touch to detect hypothermia in neonates in Indian slum dwellings. *Indian J Pediatr* 2010;77:759-62.
13. Hypothermia in Newborn. NNF Teaching Aids: Newborn Care. India.
14. Basic Newborn Care And Resuscitation Program Training Manual. Ministry Of Health And Family Welfare Government Of India: Lesson 4; Thermal protection.
15. Mizzi J, Muskat VR. Hypothermia in the early neonatal period: Follow up study. *Malta Med J* 2007;19:34-7.

Funding: None; Conflict of Interest: None Stated.

How to cite this article: Anto A, Mathew S, Shekharappa CB. Accuracy of touch method for assessing temperature in newborn. *Indian J Child Health*. 2018; 5(7):477-480.

Doi: 10.32677/IJCH.2018.v05.i07.006